Cell 22 3PW Diagnostic Beamline

IRR Functional Description

Contents

1 INTRODUCTION

The Cell 22 three pole wiggler (3PW) diagnostic beamline will utilize the 3PW radiation to measure emittance and energy spread. The whole diagnostic beamline resides inside the storage ring tunnel. The 3PW source of the beamline is identical to the other 3PWs in the ring. At Cell 22, however, different to the standard beamline front end, light from the 3PW is directed to optical tables within the storage ring enclosure and is terminated within that enclosure; there is no ratchet wall penetration.

A 0.5 mm thick diamond window separates the storage ring vacuum and beamline vacuum, with aperture of 1mm x 5mm (HxV). The window is water cooled and has been installed since 2014. A low vacuum extension pipe has been installed to the optical table with a 75 micron diamond window at the end. A glidcop mask is installed upstream to protect the diamond window flanges. A pinhole assembly from tungsten bars has been installed with various pinhole sizes. The whole pinhole assembly is mounted on the motion stage and it can be fully retracted to allow the full x-ray fan passing through for the R&D development. The imaging system consists of an x-ray scintillator, lens and CCD camera, installed at the upstream optical table. An aluminum filter with varying thickness is located upstream of the imaging system to adjust the x-ray photon intensity and energy. Proper shielding around the imaging system will minimize the radiation damage to the equipment.

1.1 Primary Research Capabilities

With the 3PW pinhole beamline, one can precisely measure the electron beam emittance and energy spread. The 3PW beamline locates at dispersion ~0.3m which allows precise measurement of energy spread. Compared to the existing BMA pinhole diagnostic beamline, the 3PW beamline will generate much more photons which enables the beam sizes measurement at low current studies.

2 BEAMLINE DESIGN AND COMPONENTS

A schematic layout of the beamline is shown in Figure 1, where the low vacuum pipe extends to two optical tables. Table 1 is the diagnostic table with imaging system. Table 2 is for R&D detector development.

Figure 1: Schematic Layout of C22 3PW Beamline

The diamond window, pinhole assembly, vacuum extension pipe and imaging systems are similar to the existing C22 BMA beamline. Pinhole and imaging system can be fully retracted to allow full x-ray fan passing through to Table 2 for R&D development.

Figure 2 shows major components of the imaging system. X-ray pinhole images on the scintillator screen will convert to visible light and relayed to CCD camera through 5x objective lens. Aluminum bar with variable thickness in front of the scintillator is used to filter the low energy photons.

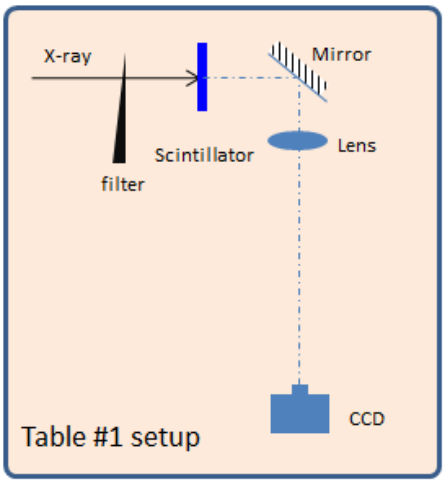

Figure 2: X-ray Pinhole Imaging System

3 COMMISSIONING AND EARLY STUDIES

Commissioning of the 3PW pinhole beamline including the following steps:

- 3PW moves in, lattice/orbit correction
- Search to x-ray radiation from 3PW
- Align the pinhole
- Optimize imaging system focusing, filter etc.
- Check lowest beam current able to be measured
- Resolution study

Together with the commissioning, some early studies using the 3PW can be carried out. These include the emittance and energy spread measurement; transient profile measurement after pulse kick or injection.

4 BEAMLINE STAFF

The 3PW pinhole beamline will primarily be executed/supported by:

W. Cheng, B. Bacha, B. Kosciuk, D. Padrazo and the NSLS-II Diagnostics Group. Y. Hu and C. Guerrero, will provide controls support.

5 BEAMLINE SAFETY

The entire beamline is contained within the storage ring tunnel. As a result, there are no additional radiation shielding requirements beyond those of the storage ring itself. Since there is no access to the endstation during Operations, there is no PPS system.

Downstream diamond window of the extension vacuum pipe has included GlidCop absorber to protect possible mis-steered beam.

6 INSTRUMENT READINESS

The 3PW has been installed and is ready to be moved in once approval is received. The diamond window separating the storage ring vacuum has been installed and operated since 2014. The low vacuum pipe has been installed and under vacuum for the past few months. The pinhole assembly, imaging system, filter and their motors have been installed and tested.